ECOLOGY :

Ecology is the study of the interactions of living organisms with Their environment . Ecology is a broad term which is also known as bio ecology, Bionomics or environmental biology as it specifically studies the Relationship between the organisms and the environment.

Term Ecology has been derived from two Greek Word i.e Oikos means Household or Home or Place to Live & Logos means to Study .

So Ecology means Study of Organism at their home .

Term Ecology has been coined by E. Haeckel in 1869 .

Before Oekologie now Ecology .

In General , Study of reciprocal relationship between organism and Environment is Called As Ecology .

Father of Ecology = Reiter

Father of Indian Ecology = Ramdeo Mishra

- **Organisms are basic unit of Ecology .**

Flora denotes Plants and Fauna denotes Animal .

Ecology has two branches i.e

Autecology : Relationship between Environment and an Organism

Synecology : Relationship between Environment and Community

Community : The Group of Organisms of different species living in the same area and interacting with Each other .

Niche – It Includes habitat as well as functional role of an organism in the community . This Term Was Used by Grinnel .

ECOSYSTEM

Structural and Functional unit of Communities and their Environment is Called as Ecosystem .

Term Ecosystem was given by A.G Tansley in 1935 .

"Eco-system is defined as a self regulating group of biotic communities of species interacting with their non living environment exchanging energy and matter."

Study of ecosystems is called as **Ecology** or the study of organisms in their natural home interacting with their surroundings is called **Ecology.**

STRUCTURE OF ECO-SYSTEM

The structural attributes (components) of these components are:

- Biotic components
- Abiotic components

1. Biotic components: These constitute all the living members of an eco-system.
Ex. Plants, animals and micro organisms. These are of three types:

- Producers
- Consumers
- Decomposers

Producers- These are constituted mainly by green plants. Green plants trap solar energy and converts into potential chemical energy in the process called photosynthesis. These species are also known as Photo- autotrophs.
The plant species which live inside the ocean waters prepare their food in the absence of sunlight by the oxidation of chemicals and they are known as chemo-autotrophs and the process is called chemosynthesis. (Sulphur bacteria)
Consumers- Organisms which get their food by feeding on other organisms are called consumers.

a. **Herbivores-** they feed on plant species (primary consumers) eg- rabbit, insects
b. **Carnivores- (Secondary Consumer)**they food on herbivores and other carnivores eg- frog, snake
c. **Omnivores- (Tertiary Consumer)** they feed on both plants and animals. Eg- humans

Decomposers- they derive their food by breaking down the complex organic molecules to simple organic compounds and finally to inorganic nutrients. Eg- bacteria, fungi
Also Known As Detritivores- they feed on parts of dead organisms, waste of living organisms etc. Eg- earthworms, ants.
Transformer or Scavengers Saprotrophs .

2. **Abiotic components: -** Abiotic components of an eco-system consist of non living substances and factors. They are broadly divided into Physical and chemical factors.
   - Physical factors include temperature, wind, soil type, water availability, humidity, precipitation, light, etc.
   - Chemical factors include nutrients like Carbon, Nitrogen, Phosphorous, potassium, topography, pH of the soil, etc.

TYPES OF ECOSYSTEM :

Two types of Ecosystem i.e Terrestrial and Aquatic .

Forest Ecosystem : Like Normal Ecosystem Components are almost same .

Pond Ecosystem :

Producer – Submerged hydrophytes like Hydrilla , Vallisnaria , Salvinia , Lemna , Azola etc . And also includes phytoplanktons like Volvox , Spirogyra etc .

Primary Consumer – Mostly Zooplankton like Euglena

Secondary Consumer – Frog , Small Fishes who eats Pr. Consumer

Tertiary Consumer – Carnivores

Decomposer – Bacteria and fungi

FUNCTIONS OF ECO-SYSTEM:
Eco-systems have some functional attributes due to which components remain and running together. The tendency of every eco-system depends on various function performed by the

structural components of the eco-system.

Productivity –

Producer forms whatever called as Primary Productivity . It is of 2 types

Gross Primary Productivity / GPP – Total Energy Fixed in Ecosystem

Net Primary Productivity / NPP – Rest

Respiration / R

GPP = NPP + R

- **Maximum or Highest Productivity – Tropical Rain Forest**
- **Lowest Productivity – Desert or Tundra**

The main functional attributes of eco-system are:

I. Food Chain & Food Web.
II. Energy flow
III. Ecological pyramids
IV. Ecological regulation
V. Ecological succession

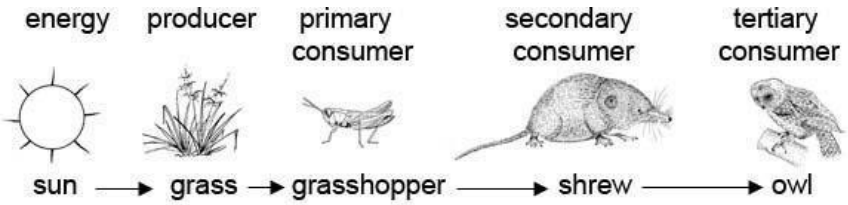
I. Food chain: The transfer of food, energy from producers through a series of organisms with repeated eating and being eaten is known as a food chain.

Prey:

Prey is defined as the animals that are haunted and killed by another animal for food.

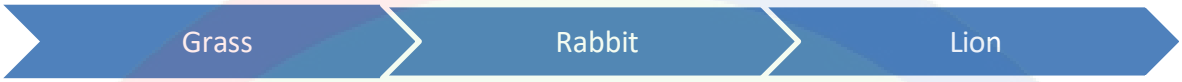
Predator:

A predator is defined as an animal that hunts and kills another organism for food and for the fulfillment of nutritional requirements.



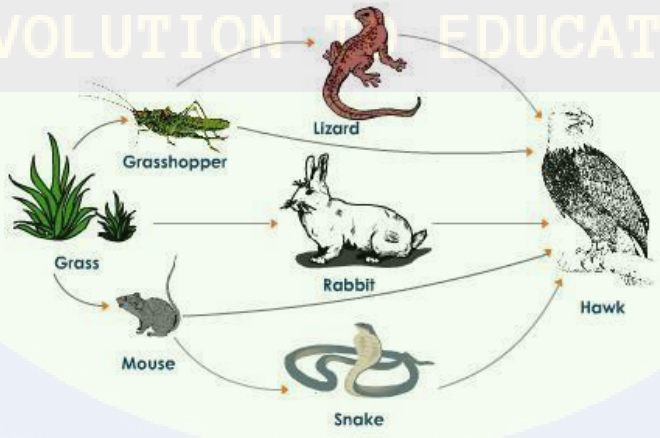
Types of food chains: There are 2 types of food chains:

a. **Grazing food chain:** This type of food chain starts from the living green plants goes to grazing herbivores and onto carnivores, eco-systems with such type of food chains are directly depend upon the influx of the solar radiation. Most of the eco-systems in nature follow this type of food chain.



b. **Detroiter's food chain:** This type of food chain goes from dead organic matter into micro organisms and then to organisms which feed on detritivors (decomposers) and predators. Such eco-systems are not dependent on direct solar energy and chiefly depend upon the influx of dead organic matter produced in other eco-systems. Ex: bacteria and fungi feeding on dead organic matter and are eaten by small fish which act as prey to large fish or birds.

Food webs: A complex network of interconnected food chains of different tropic levels in a Biotic community is termed as a food web.
The complexity of any food web depends upon the diversity of organisms in that ecosystem. Thus, each species of any eco-system is indeed kept under some sort of a natural check so that the eco-system may remain balanced and this is the significance of a food web.
Example-



A Food Web in a Grassland Ecosystem With Five Possible Food Chains

Significance of food chain & food web-

a. They maintain the ecological balance by regulating the nutrient cycles.
b. Biological magnification- It is a process in which the concentration of the non-biodegradable material or any fertilizer accumulates in the food chain. As human beings occupy the highest position in the tropic level, they get highly bio-magnified which is harmful. Ex:- DDT (dichloro diphenyl trichloro ethane) is an insecticide used

for killing insects. Excess usage of this non-biodegradable chemical makes the soil over nourished and its concentration increases as it passes along the food chain.

II. Energy flow- All eco-systems are energy driven complexes. The energy concerned to eco-system is light energy, chemical energy, heat energy and the source of all these energies is "solar energy". This energy gradually transfers to light, chemical and heat energy. 1% of total energy falling on plants used for photosynthesis and this is only source of energy for proper functioning of the eco-system.

The fixation of solar energy by the plants and its utilization in the form of food by living organisms obey the 2 laws of thermodynamics.

1st law: Energy can neither be created nor destroyed; it can only transfer from one form to another.

2nd law: It states that every transformation of energy is accompanied by a simultaneous degradation of energy from concentrated form to disperse. Flow of energy is always uni-directional.

Energy Flow Models:

Energy flow in various trophic levels of an ecosystem can be explained with the help of various energy flow models. They are;

A. Universal Energy Flow Model

B. Single Channel Energy Flow Model

C. Double channel or Y-shaped flow model

Universal energy flow model:

This model tells, as the energy flow takes place, there is a gradual loss of energy at every level as indicated in the picture. This occurs mainly due to respiration, locomotion and other metabolic activities.

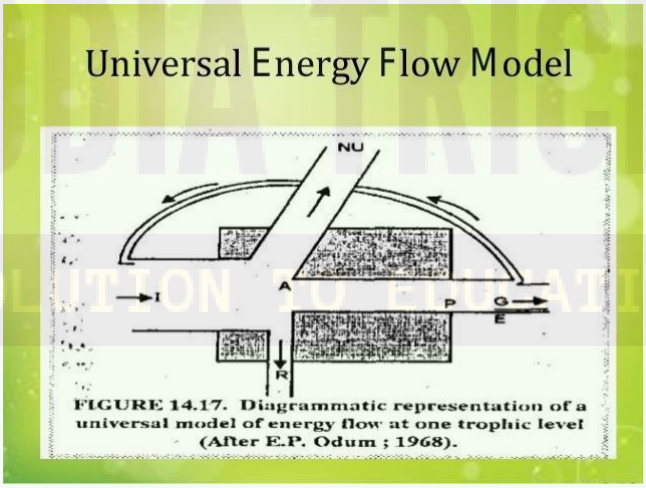


FIGURE 14.17. Diagrammatic representation of a universal model of energy flow at one trophic level (After E.P. Odum ; 1968).

Single energy flow model:

The flow of energy takes place in a **unidirectional** manner through a single channel of producers to top carnivores, and illustrated the gradual decline in energy level due to loss of energy at each successive trophic level in a grazing food chain.

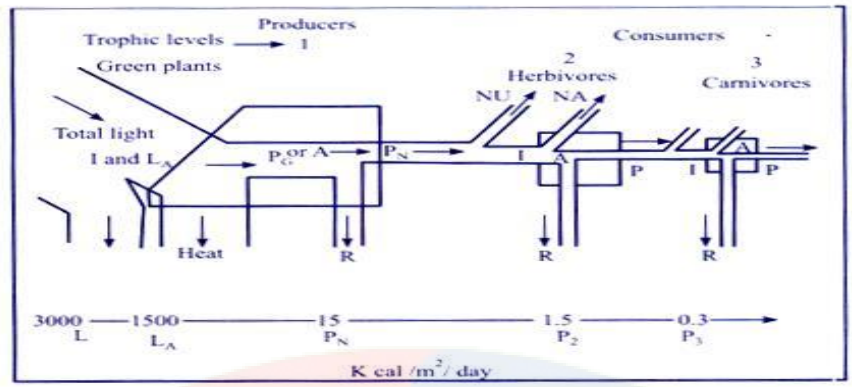


Fig. 1.4 A simplified energy flow diagram depicting three trophic levels

Double channel or Y-shaped flow model:

In nature, both grazing and detritus food chain operate in the same ecosystem. However, it is the grazing food chain which predominates. The double channel or Y-shaped flow model of energy flow shows the passage of energy through two food chains which are separated I time and space.

III. Ecological pyramids:

The graphical representation of structure and function of tropic levels of an ecosystem, starting with producers at the top and each successive tropic level forming the apex is known as an ecological pyramid.

In a food chain starting from the producers to the consumers, there is a regular decrease in the properties (i.e., energy, biomass and the number of organisms) Since some energy is lost in each tropic level, it becomes progressively smaller at the top.

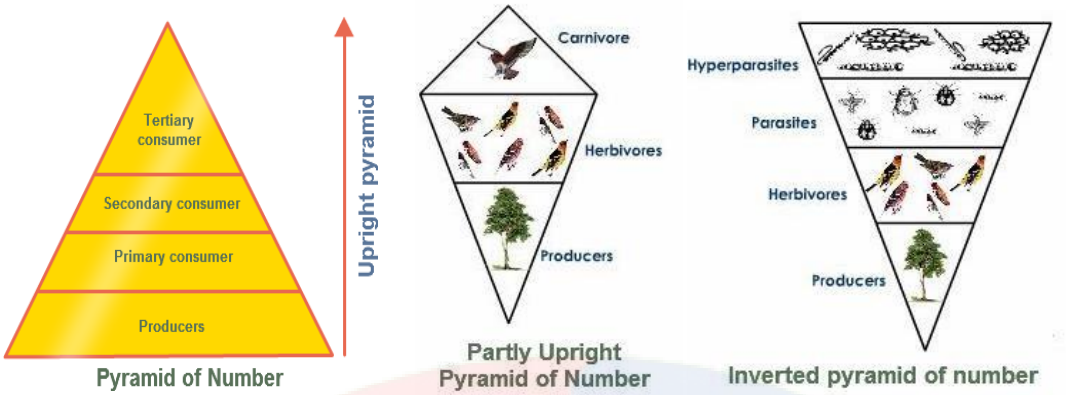
Ecological pyramids are of three types:

1. Pyramid of Numbers
2. Pyramids of Energy and
3. Pyramid of Biomass

Pyramid of Numbers It represents the number of individual organisms present in each tropic level.

Ex: A grassland Ecosystem

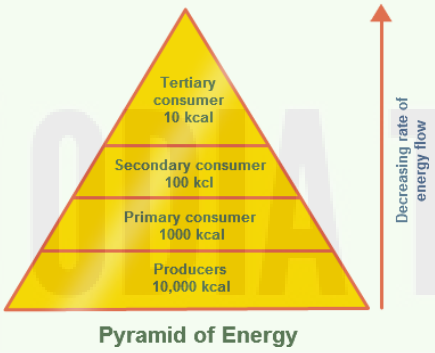
Producers are grass (small in size and large in number. Hence they occupy the first tropic level. The primary consumers are rats occupying the second tropic level. It is worthwhile to note that rats are less in number than grass. Secondary consumers are snakes which occupy the third tropic level and they are lesser in number than rats. Tertiary consumers are Eagles that occupy the next tropic level. This is the last tropic level where the number and size of the tropic level is the least as shown in the diagram.



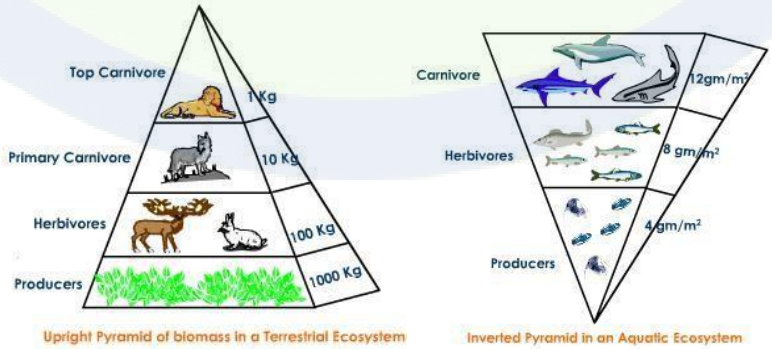
Pyramid of Energy It represents the amount of energy present in each tropic level. The rate of energy flow and the productivity at each successive tropic level is shown in the figure below.

At every successive tropic level, there is a heavy loss of energy (almost 90%) in the form of heat. Thus, at each tropic level only 10% is transferred. Hence there is a sharp decrease in energy at each and every successive tropic level as we move from producers to top consumers (carnivores).

Pyramid of energy is depicted in the figure below.



Pyramid of Biomass: It represents the total amount of biomass (mass or weight of biological material) present in each tropic level. Considering the example of a forest ecosystem, there is a steady decrease in the biomass from the lower tropic level to the higher tropic level. The producers (trees) contribute a major amount of the biomass. The next tropic levels are the herbivores (insects and birds) and carnivores (snakes, foxes, etc). The top of the tropic level consists of very few tertiary consumers (Ex: Lions and Tigers) whose biomass is very low. The pyramid of biomass is shown below



Ecological production: The rate of production of organic matter or biomass is called productivity.

This is of 2 types:

i) Primary productivity: it is defined as the rate at which the radiant energy is converted into organic substances by photosynthesis or chemo-synthesis by the primary producers. It is of 2 types:

GPP (Gross Primary Productivity): The rate at which the producers are able to utilise the radiant energy in photo or chemo synthesis to produce their food is called GPP.

NPP (Net Primary Productivity): The rate at which the energy or organic matter is stored in a producer after respiration is called NPP.

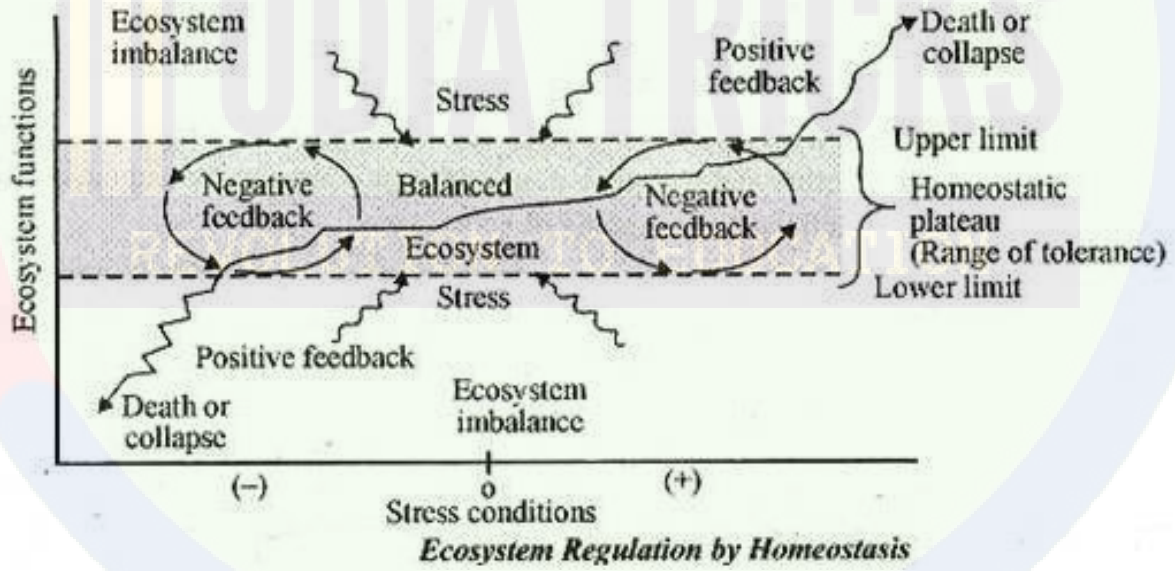
Thus, NPP = GPP-R (R= Respiratory loss)

ii) Secondary productivity: The energy stored at consumer level for use by the next trophic level is known secondary production.

IV. Ecosystem Regulation:

Ecosystem itself tries to resist to any environmental stress tries to disturb the normal ecosystem and maintain the equilibrium with the environment. This property is known as **Homeostasis.**

However, the system can show this tolerance or resistance only within a maximum and a minimum range, which is known as **Homeostatic Plateau.** Within this range, if any stress tries to cause a deviation, then the system has its own mechanism to counteract these deviations which are known as **Negative Feedback Mechanisms.** These negative feedback mechanisms try to bring the system back to its ideal conditions. But, if the stress is too high and beyond the range of homeostatic plateau, then another type of mechanism known as **Positive Feedback Mechanisms** start operating and accelerate the deviations. So these kinds of mechanisms take the system away from its ideal conditions and leads to environmental disasters.



Ecosystem Regulation by Homeostasis

V. Ecological succession: Any community tries to maintain the equilibrium with the prevailing condition of the environment. It changes with the changing environmental conditions. Sometimes the activities within the community itself or environmental changes can effect a change in the community. Eco-system development may be defined as "it is an orderly process of community development that involves changes in species structure of community processes." Finally it ends in a stabilized eco-system.

The community which develops as initial community is known as pioneer community.

The transitory communities are called as "seral stages" or developed stages.

When a system gets stabilized i.e. the final community which lasts for a longer period is known as "climax community".

Process of succession: The whole process of succession is completed through a number

of sequential steps which follows one another. Those are:

- Nudation
- Invasion
- Competition & co-action
- Reaction
- Stabilization

Nudation: This is the development of bare area without any form of life. This area may develop due to topographic (soil erosion by gravity, water, wind, land slides, volcanic activity, earth quakes etc.) or climatic like floods drought conditions, melting of glaciers, storms and biotic factors.

Invasion:

This is the successful establishment of life in that area. The species actually reaches that area from other places the forces of migration and dispersal. After reaching the new area the process of successful establishment of special is known as "ecesis". In plants seeds germinate, seedlings grow and adults start to reproduce and increase their number, this process is called "aggregation".

Competition and co-action:

After aggregation large number of individuals of species increase in a limited area, develops competition and co-action for space and nutrition. In this process changes within the community can be observed and the species is unable to complete with other number of individuals would be discarded.

Reaction:

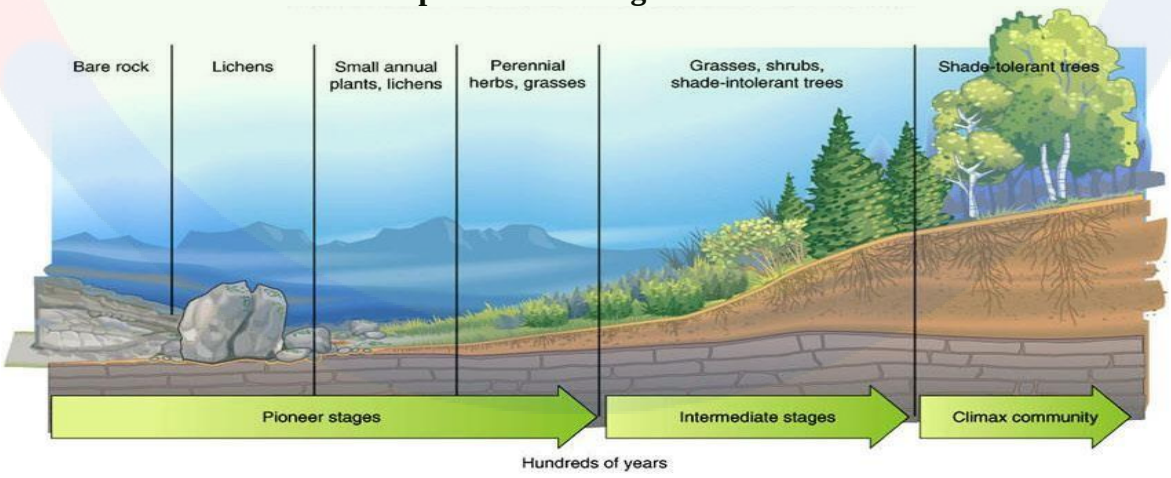
This is the most important stage in the process of succession. The mechanism of modification of environment through the influence of living organisms starts in this stage. As a result of this process changes takes place in soil, soil structures, water ph, light conditions, temperature etc. of the environment. Due to all these the environment is modified and becoming unsuitable for the existing community which sooner or later is replaced by another community.

Stabilization:

Finally there occurs a stage in the process. Then the final community or terminal community becomes more or less stabilized for a longer period of time and it can be maintain itself on equilibrium with the environment or surrounding or climate of the area.

REVOLUTION TO EDUCATION

The process of ecological succession



Example of Ecological Succession:

1) Hydrosere (Hydrarch): This type of succession start in a water bodies like pond and culminates in a climax community which is forest. It has following stages:

a) **Phytoplankton stage:** These are the pioneer community. Mainly blue green algae, green algae, diatoms and bacteria etc.

b) **Rooted submerged stage:** Due to death and decomposition of phytoplankton organic matter start accumulating on the pond subsurface. This new environment is favorable for the growth of rooted submerged hydrophytes like Hydrilla, Elodea etc.

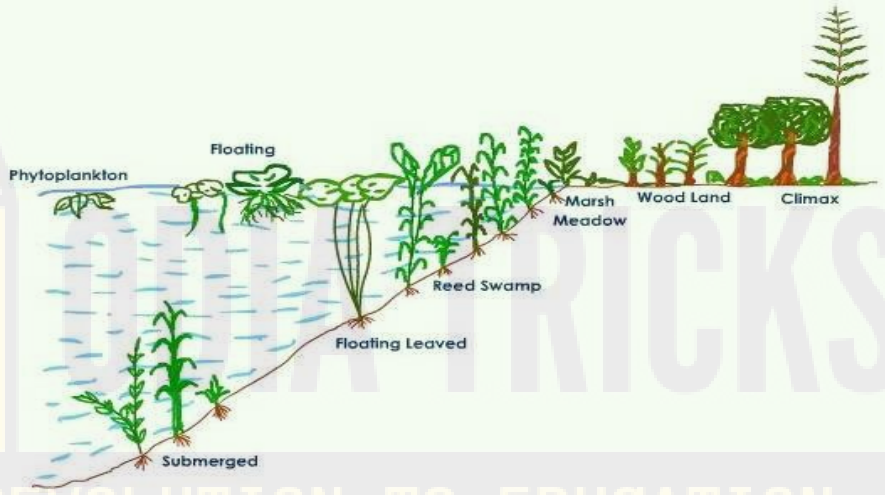
c) **Rooted submerged stage:** Now the depth of lake reduces to 2-5 feet, favoring the growth of rooted hydrophytes with their large leaves floating on the water surface. Example: Nelumbo, Trapa, Azolla etc.

d) **Reed-swamp stage:** also known as amphibious stage as the plants of community are rooted but most of it part is in air. Example: Scirpus, Sagittaria etc.

e) **Sedge-meadow stage:** They form mat like vegetation, results into higher loss of water through evapotranspiration process. The marsh like condition in the previous stage is removed and area with soil moisture left. Example: carex,cyperus etc.

f) **Woodland stage:** As the marsh land disappear soil become more dry and give rise to vegetation like shrubs(Salix, cornus) and trees (populus, Alnus).

g) **Forest stage:** This is climax community. It can developed as tropical rain forest or mixed forest depending upon the climate of the region. Example: Ulmus, Acer and Quercus.



REVOLUTION TO EDUCATION

Lithosere: A Xerosere on Rock: It start with bare rock and culminate into a forest stage. Different stages of Lithosere are as follows:

a) **Crustose lichen stage:** The lichen are the pioneer community. The substratum is very poor in moisture and organic matter, subjected with extreme of temperature. Examples: Rhizocarpon, Rinodina etc.

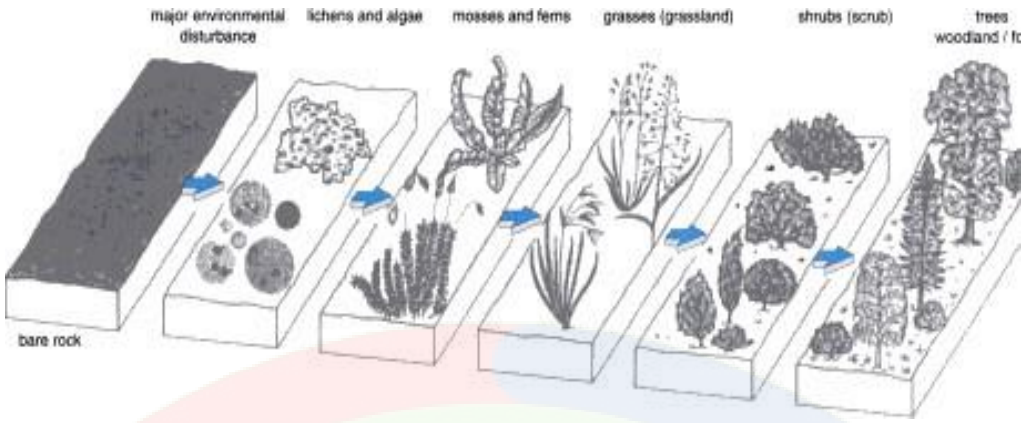
b) **Foliose lichens stage:** They can absorb more water and retain more water and are able to accumulate dust particle which further help in build up of substratum. Examples: Parmelia, Dermatocapron.

c) **Moss stage :** Xerophytic mosses such as Tortula, Grimmia appears after lichens stage.

d) **Herbs stage:** due to growth of mosses there is more accumulation of soil.This stage is constituted by shallow rooted grasses such as Aristida,Festuca etc which further replaced by shrubs.

e) **Shrub stage:** Species like Rhus, Phytocarpus start growing in the area, which over compete the herbaceous species.

f) **Forest stage:** This is the climax community for this type of ecological succession. Starting with Xerophytic tree species it changes into mesophytic type and finally into forest type.



BIODIVERSITY AND CONSERVATION

Biodiversity is defined as "***the variety and variability among all groups of living organisms and the ecosystems in which they occur***."

Levels of Biodiversity

Biodiversity is classified into three types:

1. Genetic diversity
2. Species diversity and
3. Ecosystem diversity

Genetic diversity: Within individual species, there are varieties that are slightly different from one other. These differences are due to differences in the combination of genes.

Ex: (i) Rice varieties -All rice varieties belong to the species "*oryzasativa*". However there are thousands of rice varieties that show variation at the genetic level in the form of different size, shape, colour and nutrient content.

(ii) Teak wood varieties: The various teak wood varieties available are - Indian teak, Burma teak, Malaysian teak etc.

Species diversity: Species diversity is the diversity between different species. The sum of varieties of all living organisms at the species level is known as species diversity.

Ex: The total number of species living on earth is approximately more than 2 million. However, only around 1.5 million are found and assigned scientific names.

Plant species: Apple, Mango, Wheat, Grapes, Rice etc.

Animal species: Lion, Tiger, Elephant, Deer etc.

Ecosystem diversity:The diversity at an ecological level or habitat level is known as ecosystem diversity.

Ex: River ecosystem, Rivers include fish, aquatic insects, mussels and a variety of plants that have adapted.

VALUES OF BIODIVERSITY

Definition and estimation of the value of biodiversity is not easy. The value of biodiversity is classified into:

1. **Direct Value and**
2. **Indirect Value**

Direct value of biodiversity is of two types

1. Consumptive use value and
2. Productive use value

C**onsumptive use value:** The consumptive use value is the value placed on nature's products that are consumed directly, without passing through a market.

Food: Plants: Most fundamental value of biological resources particularly plants is providing food. i.e., Wheat, Maize and rice constitute 2/3rd of food requirement all over the world.
Fish: Through the development of aquaculture, techniques, fish and fish products have become the largest source of protein in the world
Fuel: Since ages forests have provided wood as fuel. Fossil fuels like coal, petroleum, natural gases are also product of biodiversity.
Drugs and Medicines: Traditional medicinal practices such as ayurveda utilize plants or their extracts directly. Many drugs were derived from plants
Quinine: Famous anti malarial drug is obtained from the bark of Cinchona tree
Penicillin: Famous antibiotic is derived from Pencillium, a fungus
Tetracycline: Obtained from Bacterium
Vinblastin and Vincristine: Anti-cancer drugs obtained from Catharanthus plant which has anti cancer alkaloids
High consumptive use values on resources may lead to the following problems:

1. Over-exploitation of wildlife in developing countries
2. Loss of traditional controls on hunting and
3. Loss of wildlife populations at productive levels.

Productive use value: Productive use value refers to products that are commercially harvested (sold in a national and international market). Many industries are dependent upon these values. Textile, Leather, Silk, Paper and Pulp industry etc. Productive use value is often the only value of biological resource reflected in national income accounts and may have a major impact on the national economy.

Indirect values of biodiversity

Biodiversity provides the benefits to human beings supporting the existence of biological life and other benefits which are difficult to quantify. These include the following values
Social and cultural value: Many plants and animals are considered holy and sacred in India and are worshiped like tulsi, peepal, cow, snake etc. In Indian society great cultural value is given to forest and tiger, peacock and lotus are named as national animal, bird and flower respectively
Existence value or Ethical Value: These values are associated with conservation of biodiversity where ethical issue of "all life forms must be preserved" is laid down. There is an existence value which is associated to each species because biodiversity is valuable for the survival of human race.
Optional value: This refers to the potential of biodiversity that is currently known and needs to be explored. This refers to the idea that there may be several existing species that may prove to be important in future and their usefulness needs to be studied with reference to a specific problem currently plaguing the society.
Example:

1. The growing biotechnology field is searching for the cure for diseases like cancer and AIDS.
2. Medicinal plants and herbs play a very important role in the economic growth of our country.

Aesthetic Values: There is a great aesthetic value which is attached to biodiversity. Natural landscapes at undisturbed places are a delight to watch and also provide opportunities for recreational activities like bird watching, photography etc. Beautiful plants and animals inspire us to protect biodiversity. The most important aesthetic value of biodiversity is eco-tourism. Eco-tourism further generates revenue by designing of zoological, botanical gardens, national parks, wildlife conservation etc.
Ecosystem services value:

- Production of oxygen by land based plants and marine algae
- Maintenance of fresh water quality by vegetation slowing run off, trapping sediment and removing nutrients and by soil organisms breaking down pollutants
- Production and maintenance of fertile soil as a result of many interacting processes

- Provision of foods such as fish, pastures for cattle and sheep, timber and fire wood
- Maintenance of habitat that are attractive to humans for recreation, tourism and cultural activities and that has spiritual importance
- Pollination of agricultural crops, forest trees and native flowering plants by native insects, birds and other creatures
- Breakdown of pollutants by micro-organisms in soil and aquatic ecosystems and sequestration of heavy metals in marine and fresh water sediments

THREATS TO BIODIVERSITY

Any disturbance in a natural ecosystem tends to reduce its biodiversity. Waste generated due to increase in human population and industrialization spoils the environment and leads to decreased diversity in biological species. Any change in the system leads to a major imbalance and threatens the normal ecological cycle. Causes for loss of biodiversity are:

1. Habitat loss
2. Poaching of wildlife and
3. Man-wildlife conflicts

Habitat loss:

The loss of populations of interbreeding organisms is caused by habitat loss. Factors influencing habitat loss are:

1. **Deforestation:** Loss of habitat is mainly caused by deforestation activities. Forests and grasslands are cleared for conversion into agriculture lands or settlement areas or developmental projects. Forests and grasslands are natural home to thousands of species which disintegrate due to loss of their natural habitat.
2. **Destruction of wetlands:** Wetlands, estuaries and mangroves are destroyed due to farming, filling and pollution that cause loss of biodiversity
3. **Habitat fragmentation:** When the habitat is divided into small and scattered patches the phenomenon is called habitat fragmentation. This leads to the disappearance of most wildlife
4. **Raw material:** To produce hybrid seeds, wild plants are used as raw materials leading to extinction of many wild plant species.
5. **Production of drugs:** Pharmaceutical companies collect wild plants for the production of drugs leading to extinction of several medicinal plant species.
6. **Developmental activities:** Construction of dams in forest areas coupled with the discharge of industrial effluents kills birds and other aquatic life.

Poaching of wildlife:

Poaching refers to killing animals or commercial hunting. It contributes to loss of biodiversity. Poaching can be of two types listed below:

- **Subsistence poaching:** This refers to killing animals for survival.
- **Commercial poaching:** This refers to hunting animals in order to sell their products.

Factors influencing poaching

1. **Human population**: Increased human population in India has led to pressure on forest resources, leading to degradation of wildlife habitats
2. **Commercial activities**: Although a ban has been imposed internationally on the trade of products of endangered species, there is a continued smuggling of wildlife products. Since trading of such products is highly profitable, poachers continue to hunt endangered animals and smuggle their fur, skin and tusks to other countries.

Wildlife products include *furs, horns, tusks, live specimens and herbal products*. *Richest source* of biodiversity lies in developing nations in *Asia, Africa and Latin America*.

Advanced countries like *Europe, North America, Japan, Taiwan, Hong Kong* are the *major importers* of wildlife products.

MAN-WILDLIFE CONFLICTS

Man-wildlife conflicts arise, when wildlife starts causing immense damage and danger to man. Under such conditions it is very difficult for the forest department officials to convince the affected villagers to gain the support of villagers for wildlife conservation.

Examples:

1. In Sambalpur, Orissa, several people were killed by elephants. In retaliation, the villagers killed and injured several elephants.
2. In Mysore, elephants were killed by farmers in retaliation to the damage done by elephants to their cotton and sugarcane fields.
3. Villagers sometimes hide explosives in their fields to ward-off animals which explode when the elephants enter the fields
4. Several people were killed when leopards attacked them in Sanjay Gandhi National Park, Mumbai

Factors influencing man-animal conflicts

1. Shrinking forest cover compels wildlife to move outside the forest
2. Human encroachment into forest area induces a man-wildlife conflict
3. Injured animals have a tendency to attack man
4. Wild animals venture out of the forest area in search of food
5. Villager's set-up electric wiring around their fields. This injures animals (Elephants) who suffer in pain and get violent.
6. Cash compensation paid by the government is not enough.
7. Garbage near human settlements or food crops attracts wild animals

HOT SPOTS OF BIODIVERSITY

Biodiversity hotspots are areas that support natural ecosystems that are largely intact and communities associated with these ecosystems are well represented. They are also areas with high species endemism which are not found outside the hotspot.

Norman Myers has introduced the concept of Hot Spots and presently there are 34 such hot spots of biodiversity at a global level. There are two criteria for determining hot spots

i. It must contain at least 1500 species as endemics (>0.5% of worlds total)
ii. It has to have lost at least 70 percent of its original habitat (Under Severe threat)

Hot spots once covered 15.7% earths land surface but today total hot spot cover is 2.3%

Reptiles and Amphibians are more prone to hot spot endemism

Hot Spots in India

In India we have 3 biodiversity hot spots

Western Ghats:

- Western Ghats region is spread over 6 states of India, they receive high rain fall.
- This region shows high species diversity and high levels of endemism.
- Nearly 77% of amphibians and 62% of the reptile species found here are endemic.
- The highest concentration of species in Western Ghats is believed to be in Agasthyamalai hills in extreme south.
- Western Ghats faced with tremendous population pressure; forests of the Western Ghats have been dramatically impacted demands for timber and agricultural land.
- At least 325 globally threatened species occur in Western Ghats.
- It was found that loss of biodiversity in Western Ghats is about 2.4% per year.

Eastern Himalayas:

- The Himalayan hot spot is home to the world's highest mountains including Mount Everest.
- This region is geologically young and shows high altitudinal variation.
- World's major river systems arise in Himalayas and their combined drainage basin is home for 3 billion people in 18 countries.
- Eastern Himalayan hot spot has nearly 163 globally threatened species including Rhinoceros, Wild Asian Water buffalo and in all 47 mammals, 50 birds, 17 reptiles, 12 amphibians, 36 plant species.
- There are 10,000 species of plants in Himalayas of which 1/3rd are endemic and found nowhere else.

Indo-Burma Hot Spot:

- Indo-Burma region is spread out from Eastern Bangladesh to Malaysia including north-eastern states and is spread over 2 million sq.km of tropical Asia.
- Most of this region is still a wilderness, but has been deteriorating rapidly in the past few decades.
- In recent times six species of large mammals have been discovered here. This region is home to several species such as monkeys, langurs and gibbons.
- Almost 1300 bird species and 13,500 plant species are existing in this region and half of them are endemic.

INDIA AS A MEGA BIODIVERSITY NATION:

India is one of the 17 mega-diverse nations, is one of the richest nations in terms of biological diversity.

- India contains about 8% of the world's biodiversity.
- India is home to about 5 world heritage sites
- India Ranks 10th among the plant richness countries
- Indian ranks 6th among centre of biodiversity and origin of agricultural crops.
- With only 2.4% of world's land area, accounts for 8% of the species of the world. About 47,000 plant species and 81,000 animal species of India are endemic which are 7% and 6.5% of global diversity respectively
- A large number of species which are originated in India are called as centre of origin
- Nearly 5000 species of flowering plants, 160 species of crops and 320 species of wild relatives of cultivable crops having centre of Origin in India
- India having about 7500 KM long coastal line
- It majorly contains Mangroves, Estuaries and Back waters where 340 species of corals of the world are found
- A large portion of Indian Biodiversity is still unexplored
- Due to very diverse climatic conditions there is a major diversity of species exists in our country

CONSERVATION OF BIODIVERSITY

Biodiversity is one of the important tools for sustainable development. The commercial, medical, genetic, aesthetic, and ecological importance of biodiversity emphasizes the need for its conservation.

There are two types of biodiversity conservation:

1. In-situ conservation
2. Ex-situ conservation

In-Situ Conservation

In-situ conservation involves protection of flora and fauna within its natural habitat. The natural habitats or ecosystems under in-situ conservation are called "protected areas".

1. Biosphere reserves
2. National parks
3. Wildlife sanctuaries

4. Gene sanctuaries

Biosphere reserves cover large areas (>5000 sq.km.) They are normally used to protect species for a long time. The roles of biosphere reserves are listed below:

1. Long-term survival of evolving ecosystem
2. Protect endangered species
3. Protect maximum number of species and communities
4. Serve as site of recreation and tourism
5. May also be used for educational and research purposes

Biosphere reserves function as an open system and changes in land use are not allowed. No tourism and explosive activities are allowed in biosphere reserves.

A **national park** is an area dedicated for the conservation of wildlife along with its environment.

It covers an area ranging from 100 to 500 sq.km. One or more national parks may exist within a biosphere reserve.

- A national park is used for enjoyment through tourism, without affecting the environment.
- It is used to protect, propagate and develop wildlife.
- Grazing domestic animals inside national parks is prohibited
- All private rights and forestry activities are prohibited inside a national park

A **Wildlife sanctuary** is an area that is reserved for the conservation of animals only.

1. It protects animals only
2. It allows operations such as harvesting of timber, collection of forest products, private ownership rights and forestry operations, provided it does not affect animals adversely

Green sanctuary is an area where plants are conserved.

Other projects for the conservation of animals are *Project Tiger, Gir Lion Project, Crocodile breeding project, project elephant etc*

Advantages of in-situ conservation

1. It is cheap and convenient
2. Species get adjusted to natural disasters like drought, floods, forest fires etc.

Disadvantages of in-situ conservation

1. A large surface area of earth is required to preserve biodiversity
2. Maintenance is not proper due to shortage of staff and pollution

<u>Ex-situ conservation</u>

Ex-situ conservation involves protection of flora and fauna outside their natural habitats. This type of conservation is mainly done for conservation of crop varieties and wild relatives of crops.

1. Ex-situ conservation involves maintenance and breeding of endangered plant and animal species under controlled conditions
2. It identifies those species that are at a high risk of extinction
3. It prefers species that are important for man in the near future among the endangered species.

Methods of ex-situ conservation

<u>National Bureau of Plant Genetic Resources</u> (NPBGR) It is located in New Delhi and uses the Cryopreservation Technique to preserve agricultural and horticultural crops.

Cryopreservation technique involves using liquid nitrogen at -196 ^{O}C. Varieties of rice,

turnip, radish, tomato, onion, carrot, chilli, tobacco have been successfully preserved for years using this technique.

National Bureau of Animal Genetic Resources (NBAGR) It is located in Karnal, Haryana and preserves the semen of domesticated bovine animals.

National Facility for Plant Tissue Culture Repository (NFPTCR) In this facility, conservation of varieties of crop plants or trees is done using tissue culture. This facility has been created within the NPBGR.

Advantages of Ex-situ conservation

1. Survival of endangered species is increasing due to special care and attention
2. In captive breeding the animals are assured of food, water, shelter and security thereby have a longer life span
3. It is carried-out in cases of endangered species that do not have any chance of survival in the wild

Disadvantages of Ex-situ conservation

1. It is an expensive method
2. Freedom of wildlife is lost
3. Animals cannot survive in the natural environment

ENDANGERED SPECIES OF INDIA

A plant, animal or microorganism that is in immediate risk of biological extinction is called **endangered species** or threatened species. In India, 450 plant species have been identified as endangered species. 100 mammals and 150 birds are estimated to be endangered. India's biodiversity is threatened primarily due to Habitat destruction, Degradation and over exploitation of resources

The International Union for Conservation of Nature (IUCN) **RED-data book** contains a list of endangered species of plants and animals. It contains a list of species of that are endangered but might become extinct in the near future if not protected.

Some of the rarest animals found in India are Asiatic cheetah, Asiatic Lion, Asiatic Wild Ass Bengal Fox, Indian Elephant, Indian Rhinocerous, Marbled Cat and Markhor

Extinct species are the species that are no longer found in the world.

Endangered or threatened species is one whose number has been reduced to a critical number**.** Unless it is protected and conserved, it is in immediate danger of extinction.

Vulnerable **species** is one whose population is facing continuous decline due to habitat destruction or over exploitation. However, it is still abundant.

Rare species is localized within a restricted area or is thinly scattered over an extensive area. Such species are not endangered or vulnerable.

A few endangered species in the world are such as West Virginia Spring Salamander (U.S.A), Giant Panda (China), Golden Lion Tamarin (Brazil), Siberian Tiger (Siberia) Mountain Gorilla (Africa), Pine Barrens Tree Frog (Male)

Other important endangered species are Tortoise, Green sea Turtle, Gharial, Python (Reptiles), Peacock, Siberian White Crane, Pelican, Indian Bustard (Birds).

Endemic species of India

Species that are found only in a particular region are known as endemic species. Almost 60% the endemic species in India are found in Himalayas and the Western Ghats.

Endemic species are mainly concentrated in North-East India, North-West Himalayas, Western Ghats and Andaman & Nicobar Islands.

Factors affecting endemic species:

1. Habitat loss and fragmentation due to draining and filling of inland wetlands.
2. Pollution also plays an important role.